

intensity were characteristic of aurora, which is not very common at this season of the year, I think. F. T. MOTT
Birstal Hill, Leicester, August 13

WE had a fine aurora here last night (11th). There was a bright bank of uniform glow till 11 p.m., when it suddenly broke into streamers, some of which reached 40° or 45° in height, the glow extending along 100° or 120° of the horizon. There was no colour, and by midnight it had all faded out.

Whitby, August 12

B. W. S.

Height of the Aurora

I SHALL be glad if you will allow me the use of your columns to point out that there is really less uncertainty about this element than is usually supposed, and that there are two methods of measuring auroral heights which give accordant results. The first is that based upon the measurements of the altitude and amplitude of auroral arches, and which gives the results mentioned by Mr. Rand Capron. That these results should have so wide a range is probably owing to the fact that they proceed upon an assumption which may or may not be correct, viz., that the arch is part of a circle having the magnetic pole for its centre. Still the mean result from this method would seem to be reliable, especially if care were taken to exclude doubtful measurements from the list. Possibly we may assume that this method gives a height not far from 100 miles for the ordinary arch. I speak particularly of the white auroral arch with or without uncoloured streamers that forms, I suppose, 95 per cent. of the auroral phenomena visible in this country. These arches are formed for the most part over a portion of the earth considerably to the (magnetic) north of these islands, but occasionally they would seem to be formed over our heads. Mr. Capron in his work on "Auroræ and their Spectra" mentions one such instance, though he appends no explanation of the phenomenon, but in the course of ten years' observations I have myself seen three such arches. Indeed they are perfectly well known to observers in Scotland and the north of England, though I have never seen them in the south. As early as the year 1843 the height of these zenithal arches had been trigonometrically computed from observations made in different localities in Britain, with the result of proving them to be at an uniform height of 70 to 74 miles above the earth.¹ There is much less liability to error in these results than in the determination of the height of a meteor, and a single pair of satisfactory observations will yield a value within one or two miles of the actual elevation.

That auroral arches are ever formed much below this limit I beg leave to doubt. I am aware of the accounts which would place them between the eye and natural objects, but such assertions are far from having the weight of accurate measurements, and I have yet to find a case of a supposed low aurora, the evidence of which is above criticism.

I do not wish to assert that the streamers at right angles to these arches may not be frequently visible at a less height, just as they undoubtedly reach to a much greater elevation in the region where the auroral crown is formed. But to fix either the superior or inferior limit is precisely one of those questions which we can have no hope of solving by direct measurement, since the length of the streamer varies with the force of electric discharge. This is shown by the fact that in an active aurora some streamers extend only a short distance from the arch, while others will climb up to the vanishing point, or crown.

To carry these remarks so as to include the question of coloured auroræ would oblige me to trespass more upon your space than I am willing to do on this occasion.

Orwell Park Observatory, Ipswich JOHN I. PLUMMER

Fire-Ball

ON the evening of the 12th a very brilliant fire-ball fell at 8h. 30m. G.M.T. It was first observed at an elevation of about 25° above the E.S.E. horizon, and its path was inclined at an angle of about 35° to the horizon. It was lost in the mist near the south horizon. There was no explosion or noise of any kind. The daylight was still fairly strong, and yet the light of the meteor was very dazzling.

S. J. PERRY

Stonyhurst Observatory, August 15

¹ I give these figures from memory, as I have no library at hand to which to refer, but I have no doubt that they are strictly correct. Mr. Capron may perhaps find some information on the point in the published works of the late Prof. Phillips, who was one of the observers engaged in these investigations about the date I have named, or they may be verified upon the first appearance of a zenithal arch.

Atmospheric Phenomenon

A CURIOUS phenomenon was observed here after sunset the night before last, and again in a less degree last night.

Looking across from this point to the position of the sun at and after setting, the line of sight crosses about three miles of sea, then about the same distance or rather less of projecting high ground, and beyond that many miles of sea again. On Tuesday (10th) the sun set in a hot haze, and half an hour after there appeared on the edge of the projecting land what looked like tongues of flame fifteen to thirty minutes in height, lasting from two to four seconds each, and then disappearing in different places, sometimes half a dozen at a time. At the same time there was more or less of a flickering light along the whole line of projecting land.

My first impression was that it was an optical illusion, and the second that a moor was on fire behind the ridge, and that these were points of flame. The first was negated by the fact that four others beside myself (two of them with very keen sight) saw the lights independently in the same places; and the second by the gradual fading of the light as the evening became darker, the "tongues" retaining pretty much their relative brightness to the general glow until both faded out.

The day had been extremely hot, and the evening was sultry, with motionless air. I imagine the appearance was due to irregular refraction, arising from heated currents of air from the cooling land, and that the circumstance of the *slice* of land with its currents occurring between the two stretches of homogeneous air over the sea allowed the effect to be seen without being masked, as it would have been had there been intervening land. But I never saw it before, and don't remember to have seen it described.

B. W. S.

Whitby, August 12

Intellect in Brutes

INSTINCT apart, cases of intelligence in animals are very numerous, of the affections still more numerous. Comte was of opinion that the affections were even more highly developed in animals than in men. The dog will lay down life for the man he loves, the horse will do so likewise. We have all heard of Greyfriars Bobby, if that be the creature's name. But instances crowd on the memory. A few years back, during a heavy gale, a sweep of the spanker-boom drove the master of a Leith and London smack into the sea. Instantly the ship's dog bounded in after, and, sustaining the drowning man, both passed grandly into the eternities together. I have known cats who let themselves into the dwelling-house at pleasure, and at least three dogs who were wont to deposit the pennies given them on the counter of some baker or pastry-cook in return for values received. I used to meet on the highway a dog who rode behind his master's groom. The hardest trot never seemed to discompose his seat. Even birds—not merely trained birds—sometimes display singular attainments. I knew a lady who had a singing duck, but being one day at a loss for a couple, she sacrificed the songstress to make up a pair. One wishes that she had displayed a little more humanity; as also a clergyman, not a hundred miles from where I sit, who ordered a goose that had evinced the warmest attachment to be slain by reason of the poor bird having followed him on the occasion of paying a visit into a friend's drawing-room.

When a boy I used to spend many a holiday at a farmer's house in the County Armagh. I there experienced great kindness, enjoying myself as much as was well possible in the open air, the garden, and the stubble fields. Besides human beings, I had numerous playmates too in the kine, swine, dogs, fowl, horned cattle, and horses about the place, and indeed was never tired in observing their modes of living and acting. The great house-dog used often to play with a large hog. They alternately chased and faced one another till the hog's chaps would froth again actually with the excitement of the sport. At first I supposed that the pig did not like it, but in this I was mistaken. One day a strange dog, an immense brute, made his appearance, and attacked the house-dog, who was evidently getting the worst of it, when who should come to the rescue but the hog, who instantly jumped on the strange dog's back, assailing him at the same time with hoof and tooth. Placed thus between two fires, the stranger beat a speedy retreat, leaving the friends complete masters of the situation.

I think I was about ten years old when my parents went to reside at a place called Fairlawn, situated on a gentle eminence a few miles from the mutually contiguous towns of Moy and

Charlemont. Facing the house, a stone's throw or two in front of the lawn, was a river called the Tall, which ran into the close-at-hand Callan, which again ran into the Black Water, which, in turn, emptied itself into that immense puddle which bears the name of Lough Neagh. The waters of Lough Neagh, unable, by reason of the obstructions in the Lower Bann, to escape rapidly enough into the sea, swell up and cause backwater in the rivers I have named, and others as well. The result is the periodic flooding of thousands and tens of thousands of acres of valuable land, to the immense prejudice of the occupants and country at large. The Tall, I should observe, was banked or dyked up on both sides. In some places, however, the dyke had given way, so that at flood-time—and it was flood-time at the period I speak of—the waters of the Tall were awash with those of the flooded meads on both sides. There was further a rapid current in the Tall, and before it merged into the Callan the stream had to pass under the arch of a bridge which it filled to the crown. In fact the battlements themselves were nearly covered, and the country, as far as the eye could reach from the position which I at the moment occupied at the foot of the lawn, wore the aspect of a sea. At this precise juncture two horses, whilom occupants, I presume, of the then flooded meads, were to be seen slowly wading in the direction of the Tall. The green summit of the dyke was for the most part visible, and upon this the poor brutes mounted, in quest, I suppose, of some outlet. They had not gone very far when, owing to the treacherous footing, one of the horses lost his balance and fell, rolling over and over into the Tall. He swam on bravely, the other horse stretching down at intervals a sympathising muzzle, making indeed repeated efforts to escape, but falling back each time into the surging current. I was alone, surveying the transaction, from which I never removed my eyes, with the deepest interest. All at once the horse that was on the dyke, keeping pace at a sort of half-trot with the other, burst into a hand-gallop, and when he had got sufficiently beyond his struggling comrade, bounded himself into the Tall. Swimming briskly onwards for a few fathoms, he then made his way out through what he must have seen beforehand was a practicable breach in the dyke, followed on the instant by his friend, evading, not a moment too soon, the submerged bridge, where they would have otherwise inevitably gone under. So long as my eyes could follow them they dashed onwards at a gallop, throwing up their exultant heels and flourishing their tails across the flooded meadows. It is now many years since I beheld this astonishing spectacle, which my memory recalls as freshly as if it had happened yesterday, awakening, as I think it is well calculated to do, serious reflections in regard of our mysterious associates and the wondrous Power which has called them into being, and now sustains them and ourselves alike in this transitory state which we term life.

HENRY MACCORMAC

Belfast, August

Radiation.—A Query

In Baily's experiments with the torsion-rod and two leaden balls weighing 380½ pounds each, it was found that the radiation of heat from the leaden masses affected the vibrations of the torsion-rod. These masses were thereupon gilded, and the torsion-rod protected by a gilt box covered with thick flannel, and the disturbing influence overcome. How did radiation affect the motion of the torsion-rod?

F. G. S.

"On a Mode of Explaining the Transverse Vibrations of Light"—The Expression "Radiant Matter"

WITHOUT wishing at all to underrate the apparent difficulty noticed by your New Zealand correspondent, Mr. J. W. Frankland (*NATURE*, vol. xxii. p. 317) in regard to my paper under the above heading (*NATURE*, vol. xxi. p. 256), as it would be against the interests of truth to do so; I may nevertheless call his attention to a letter of mine (*NATURE*, vol. xxi. p. 369), where an attempt is made to meet the difficulty in question. The point is to account for the circumstance (admitting that it is rendered necessary by physical evidence) that the velocity of propagation of gravity must, at least, be very much greater than that of light. I will merely confine myself here to recapitulating one of the main conclusions in a somewhat different form, viz., it appears to be necessary to look to a separate medium for gravity, or (more accurately) to one medium with particles of two grades of dimensions; the one set of particles having very

minute mass, and consequently enormous velocity, and concerned in the effects of gravity; the other set, of much greater mass and slower velocity, concerned in the phenomena of light. It will, I think, be so far tolerably evident that if the *number* of the more minute set of particles be comparatively very great, the pressure produced by them would be correspondingly great, and therefore these particles would be mainly (*i.e.*, almost exclusively, if their number were sufficiently great)¹ concerned in producing gravity. On the other hand, on account of the extreme velocity of these particles, they could not apparently be appreciably concerned in the phenomena of light, since the molecules of gross matter would vibrate among them without appreciable resistance. For it is a well-known dynamical fact that the resistance opposed to the motion of a body in a medium *diminishes* as the velocity of the particles of the medium increases. It may be worth observing perhaps that this idea of three grades of dimensions in matter (*viz.* gross matter, light-carrying matter, and gravific matter) appears to be an old one. Thus a book was published in 1827 by Dr. Blair, formerly Regius Professor of Astronomy in the University of Edinburgh, entitled "*Scientific Aphorisms*" (to which my attention was called by Prof. Tait), where the idea of three grades of dimensions in matter is set forth, and a theory of gravity very similar to that of Le Sage expounded. Also M. Prevost ("*Deux Traités de Physique mécanique*") expresses, I believe, the view that matter exists fundamentally in three grades of magnitude.

It may be rather a curious fact to notice that if the theory, that the æther consists merely of finely sub-divided matter in the ultra-gaseous state, light being regarded as a vector property carried off by the atoms in their passage through the open structure of the vibrating molecules of gross matter, as suggested by the late Prof. Clerk Maxwell, article "*Æther*," new edition of the "*Encyclopædia Britannica*" (*i.e.*, with range of free path greater than planetary distance, *NATURE*, vol. xxi. p. 256),² should ultimately turn out to be substantially true; then the term "*radiant matter*," employed by Mr. Crookes in connection with his experimental researches, would have its practical application in nature on a large scale—or light would be actually propagated by "*radiant matter*." If, on an examination of the theory in that spirit of good-humoured impartiality representing entire freedom from the predilections of any school of thought (the best guarantee of truth)—the difficulties attaching to it should not be considered insurmountable; then it may be worth remarking that the theory, without violating in the least the essential principles of the firmly-established undulatory theory, contains nevertheless (in its corpuscular essence) *one* of the ideas of Newton; so that it would appear that the latter might not have been entirely wrong, nor the upholders of the opposite view completely right, but that a partial reconciliation of their rival ideas might be possible.

S. TOLVER PRESTON

London, August 10

Earthquake in Smyrna

ACCOUNTS are freely coming forward, but they are of popular interest, seismological details being scanty. I must premise that in 1862 I took great interest in promoting Abyssinian wells in Smyrna, and that large numbers were put down. When the French Company built the quay the new works there were similarly supplied, and the result has been that for some years the surface and pipe-wells in the parallel Marina and Frank Streets have been wanting in water.

Within a few hours after the earthquake it was noticed that both classes of wells, say 600 feet from the sea, were freely supplied with water. This fact appears to me deserving of record.

It is said that the earthquake was most felt near the Greek Cathedral of St. Photius, at the Three Corners in Frank Street. It was here the ground opened in the last century earthquake and swallowed up two men, as I heard by tradition; and I always walked across the churchyard in full remembrance.

Of late years some kind of a landslip took place on Mount Pagus, or the Castle Hill, where Alexander the Great fell asleep.

¹ It may be worth noting in connection with this that (according to a principle developed by Sir W. Thomson, *Phil. Mag.*, May, 1873) it appears that if the "*elastic rigidity*" of the *larger* particles were such that they suffered no appreciable diminution of velocity at rebound from gross matter, they would not be appreciably concerned in the effects of gravity (even if their number were comparable to that of the smaller set of particles).

² Also previous papers by the present writer (on the same subject)—*Phil. Mag.*, September and November, 1877, February, 1878, April and May, 1880.